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ABSTRACT

The Pediatric Examination of Educational Readiness (PEER) was designed as an integrated health and neurodevelopmental instrument to be administered by pediatricians and nurses in the assessment of preschool children. It may be used to identify potential learning disabled children who need intervention. The neurodevelopmental part of the test included 38 items and covered: (1) spatial body awareness; (2) gross and fine motor performance; (3) visual processing; (4) auditory language function; and (5) experiential knowledge. Neurological maturation was indirectly measured from "soft signs" such as the presence of associated movements, excessive body posturing, and poorly established hand preference. Processing efficiency--the speed with which instructions were understood and carried out--was also noted. When the PEER was administered to 178 children just before kindergarten entrance, approximately ten percent were flagged as being at educational risk, as indicated by "age delayed" scores in two or more areas of the PEER. These flagged children also had lower scores on the General Cognitive Index of the McCarthy Scales of Children's Abilities and on the Kindergarten Performance Scale, a rating scale completed by the kindergarten teacher. These correlations support the concurrent and predictive validity of the PEER. (Author/GDC)

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THE PEDIATRIC EXAMINATION OF EDUCATIONAL READINESS

AN INTEGRATED HEALTH AND NEURODEVELOPMENTAL ASSESSMENT INSTRUMENT

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There is growing awareness that a significant number of school age children do not realize their full educational potential because of subtle developmental and cognitive disabilities. In many cases a child experiences years of frustration and poor academic progress before his or her problem is realized and remedial education instituted. Often by then a cycle of school failure, poor social interaction and secondary emotional problems has been established (Connolly, 1971) and there is evidence that this pattern of dysfunction and failure may continue into adult life and contribute to life-long maladjustment problems (Menkes, 1967; Poremba, 1975).

Despite the cautions and reservations appropriately expressed by some authors (Keogh, 1973) there is increasing emphasis on identifying the child with learning handicaps prior to the development of secondary cognitive and behavioral dysfunctions. If the child at risk can be identified during the preschool or early school years then early intervention may prevent more serious learning problems from developing (Haring and Ridgway, 1967).

The pediatric role in preschool assessment has not been clearly defined. It is uncertain how much a pediatric perspective can add to the evaluation performed by educators and psychologists. However, pediatricians are increasingly becoming involved in the evaluation of children with learning disabilities and are playing a more active role in preschool assessment. The traditional physical examination has been expanded to include educationally relevant developmental areas in order to describe functional strengths and weaknesses, assess the child's educational readiness and attempt to identify actual or potential handicapping conditions.

The Pediatric Examination of Educational Readiness (PEER) was designed as an integrated health and neurodevelopmental instrument to be used by pediatri-

cians and nurses in the assessment of preschool children. It was designed and is being evaluated within the Brookline Early Education Project.

The Brookline Early Education Project (BEEP) is a demonstration and research project which has been undertaking a program of early detection and education since 1973 (Pierson, 1973; Levine et al, 1977). The Project is a collaboration between the Public Schools of Brookline, Massachusetts and the Children's Hospital Medical Center, Boston. Pediatricians work closely with educators, psychologists and other professionals in an integrated multidisciplinary educational and diagnostic program. The diagnostic component of the project seeks to identify health related developmental and educational difficulties at an early age. By then planning and providing specific individualized educational programs it is hoped to minimize the incidence and impact of educational failure.

A group of young children has been enrolled in BEEP since as early as the last trimester of pregnancy. A diagnostic "package" was assembled and administered to each child at specific chronological ages. The components of the assessment at each age reflected the different perspectives of the diagnostic team, comprising pediatricians and nurse, psychologists and educators. Included were:

1. standardized psychological and developmental tests
2. direct teacher observations
3. new extended pediatric examinations which included neurodevelopmental, behavioral and stylistic observations as well as medical and neurological examinations

Within the context of BEEP, information derived from these sources has been utilized to generate specific interventions for children considered to be at risk. These have included treatment or further assessment of medical conditions, language interventions, remedial educational programs and delayed entry

into kindergarten. In addition it was possible to examine closely the role of the health professional in the developmental assessment of preschool children. Many children already undergo physical examinations before entering school. We wanted to determine whether a comprehensive expanded developmentally oriented examination administered by a pediatrician or nurse could accurately identify and assess children at educational risk as well as determine school readiness.

The PEER formed the pediatric component of the diagnostic package administered to each child at kindergarten entry. The child was also given the McCarthy Scales of Children's Abilities (MSCA) by a psychologist. This is a well-standardized, comprehensive individual test of a child's mental and motor abilities which provides a better understanding of both general intellectual level and areas of strength and weaknesses in normal children and those with learning problems (McCarthy, 1972).

In addition, each child was rated by his or her teacher on the Kindergarten Performance Profile (Walker, 1975).
subjective in nature and ask teachers to compare children in their classroom against one another, the Kindergarten Performance Profile (KPP) is a criterion-referenced, behaviorially based framework for teacher assessment of children's classroom performance. Five major areas of development were covered by 36 specific items rated on a five-point scale. The areas assessed were social skills, gross and fine motor skills, task mastery skills, academic performance, and overall school performance.

The PEER was designed as an integrated health and neurodevelopmental assessment to be administered by a pediatrician or nurse. As well as a medical and neurological examination, vision and hearing acuity were formally screened.

Findings and correlations from the health and medical part of the PEER will be the subject of a separate paper. This paper will concern itself only with the neurodevelopmental part of the exam. The developmental section of the PEER consisted of 38 separate items, the majority of which had been taken from sources previously standardized for age. The items were clustered into six developmental areas (Table 1). These were spatial body awareness, gross and fine motor performance, visual processing, auditory language function and experiential knowledge. For each item the child was assessed with regard to three categories of performance (Table 1). A developmental attainment score was given for each item according to whether the child gave an age-appropriate or delayed response. Neuromaturational status reflected the presence or absence of associated movements, excessive body posturing and poorly established hand preference. These have been called "soft signs" and were considered to be an indirect measure of neurological maturation (Touwen and Prechtl, 1970). Neuromaturational delay has often been found in school-age children with learning disabilities (Liden et al, 1977), hyperactivity and minimal brain dysfunction (Kinsbourne, 1973), and behavioral disorders. For each item in the motor areas a separate score was alloted based on the presence or absence of these soft signs. In the language section delayed neuromaturation was assessed by the presence of articulation errors and dysfluency which were considered to be due to immaturity rather than specific articulation problems. In the area of visual processing delayed neuromaturation was assessed by the presence or absence of associated movements of poorly established hand preference.

Processing efficiency was designed to reflect the speed or efficiency with which instructions were understood and the task executed. For each item specific scoring categories were formed. These included the child's latency

of response, whether repetition of instructions was necessary, and the impulsivity and self monitoring exhibited by the child.

It has been well documented that a child with attentional difficulties may be severely compromised in his or her learning (Ross, 1976). Such things as impulsivity, poor self monitoring, easy distractibility, motoric overactivity and difficulty in focusing and maintaining attention will prevent a child from learning effectively in the classroom. A 14 parameter attention-activity scale reflecting these behaviors was designed as part of the PEER (Table 2) to allow for more accurate and specific documentation of a child's behavior; the scale was scored on three separate occasions during the administration of the PEER. It was recognized that as well as varying from child to child, attention may fluctuate over time in the individual child. Thus a particular child may exhibit excellent attentional strengths in the early part of the examination but then become increasingly restive, impulsive and distractible towards the end. The attention-activity rating scales on the PEER were designed to document this behavior.

The overall consideration in the design of the PEER was to provide the pediatrician or nurse with information about a child's competence and style in a number of educationally relevant developmental areas, as well as screening for medical factors which might be constraints on learning.

PROCEDURE:

178 children, aged 4.6 - 5.7 years (mean 5.2) were recruited by mail from a listing of all children registered for public kindergarten in Brookline, Mass. No children with known severe or multiple handicaps were included. The group included 55% boys and 45% girls and was heterogenous with regard to mother's

educational level. The children were evaluated during the summer just prior to kindergarten entry. The MSCA, administered by a psychologist, was given first. The PEER was administered one week later by a pediatrician or nurse and took approximately 45 minutes. The PEER examiner did not have the results of the MSCA available. In the fall and the spring of the school year each child was rated by his or her teacher on the KPP.

For each of the six areas of the PEER, criteria were established for the developmental attainment score which resulted in a child being rated as age delayed in that particular area. Children rated as being age delayed in two or more areas were considered to be at educational risk and were flagged.

RESULTS AND DISCUSSION:

The number of children giving age appropriate responses was assessed for each item, and the mean across developmental areas ranged from 80.3 to 90%. There was no relationship between developmental attainment and the age or sex of the child. Approximately 30% of the examinations were scored both by the examiner and an observer, and there was an overall agreement of 82% for the PEER.

Correlations between each of the developmental areas of the PEER were calculated with respect to the categories of developmental attainment, neuromaturational status and processing efficiency.

For developmental attainment experiential-information correlated highly with all other areas. There were correlations between gross and fine motor function, and between fine motor function and visual processing. Auditory language function correlated poorly with visual processing and the motor areas.

For neuromaturational status there were the expected high correlations

between gross and fine motor function, and between fine motor function and visual processing. There were no correlations between auditory language function and the other areas, suggesting that language immaturity was a specific entity unrelated to immaturity in other developmental areas. There were also significant correlations between gross motor function and attention-activity ratings. That is, children with poor activity-attention scores were more likely to have signs of neuromaturational delay. For processing efficiency, there were high correlations between all developmental areas. This suggested that a child who performed "inefficiently" in one area did so in all the other areas of the PEER.

Correlations were determined between each of the attention-activity rating scales, which were given on three separate occasions. There were high correlations between the first and second scales and between the second and third, and a lower correlation between the first and third. This indicated that many children exhibited a significant deterioration in attention during the course of the examination.

According to the criteria previously discussed, approximately 10% of children were flagged as being at educational risk on the PEER. These children were then compared to the rest of the group on the General Cognitive Index of the MSCA (Table 3). The GCI index includes 15 of the 18 subtests of the MSCA and is a scaled score based on comparing a child's performance with that of his or her age mates. Those children flagged on the PEER had significantly lower GCI scores when compared to the children not flagged. This indicates concurrent validity between the developmental attainment score of the PEER and the GCI of the MSCA.

The group of children flagged on the PEER were then compared to the rest of the group on the KPP. Teachers rated the children in the fall and spring of the school year (Table 4). There were significant correlations between the

developmental attainment score of the PEER and all five areas of the KPP. That is, the children flagged on the PEER were rated significantly lower than their classmates in social skills, gross and fine motor skills, mastery skills and academic performance, and overall school performance in both the fall and spring of kindergarten. Thus the developmental attainment of a child on the PEER accurately predicted his or her kindergarten performance on a range of activities considered important by the teachers. There were no significant correlations between neuromaturational status and kindergarten performance. This confirms the view that while delayed neuromaturation is important because of its association with attentional disorders and learning disabilities in the older, school-age child, it does not by itself predict school performance. In addition delayed neuromaturation is difficult to measure in this age group because many of the abnormal neurological signs which are indices of neuromaturation in the school age child are normally present in the preschooler.

There were also correlations between processing efficiency score of the PEER and all areas of the KPP with the exception of motor skills.

In the future there will probably be increasing involvement of the health professional in the evaluation of children with learning disabilities, behavioral difficulties and other forms of developmental dysfunction (Haggerty, 1975). In addition, pediatricians and nurses will be required to play a larger role in the correlation and interpretation of a child's medical behavioral and developmental status so that, in association with educators and psychologists, an integrated functioning profile of the child's strengths and weaknesses can be constructed. This may lead to early intervention to prevent or minimize later school difficulties. The PEER was designed to be an integrated extended examination which could be used by the pediatrician or nurse to screen for developmental dysfunction which may lead to educational difficulties. These preliminary data demonstrated

concurrent validity with a standard psychological test, as well as a degree of predictive validity with respect to kindergarten performance. We feel that with further testing and refinement the PEER may be a useful instrument for use by the health professional in the assessment of school readiness and detection of subtle developmental handicaps which may lead to school difficulties.

Table 1. Correlations between subscore of PEER for developmental attainment

	1	2	3	4	5	6
1. Spatial body awareness						
2. Gross motor function	.05					
3. Fine motor function	.23	.32				
4. Visual processing	.26	.21	.31			
5. Auditory language	.32	.14	.17	.16		
6. Experiential information	.34	.24	.35	.40	.45	

Table 2. Correlations between subscores of PEER for neuromaturational status

	1	2	3	4	5	6
1. Gross motor function						
2. Fine motor function	.40					
3. Visual processing	.13	.24				
4. Auditory language	.02	.03	.02			

Table 3. Correlations between subscores of PEER for processing efficiency.

	1	2	3	4	5	6
1. Spatial body awareness						
2. Gross motor function	.32					
3. Fine motor function	.25	.29				
4. Visual processing	.28	.36	.44			
5. Auditory language	.43	.30	.27	.34		
6. Experiential information	.44	.29	.46	.50	.54	

Table 4. Correlations between the three ratings of attention-activity.

	1	2	3
1. Occasion 1			
2. Occasion 2	.54		
3. Occasion 3	.27	.68	

Table 1. PEER - Overall Design

Developmental Areas		Levels of Performance
1. Spatial body awareness	-5 items	1. Developmental attainment
2. Gross motor function	-8 items	2. Neuromaturational status
3. Fine motor function	-5 items	3. Processing efficiency
4. Visual processing	-8 items	
5. Auditory language function	-6 items	
6. Experiential-information	-6 items	

Table 2. Attention Activity Behavior Parameters - Scored on 3 Separate Occasions throughout the PEER.

1. Impulsivity-reflectivity	8. Motoric overactivity
2. Figetiness	9. Motoric underactivity
3. Distractibility	10. Adaptability
4. Perseveration	11. Responsiveness
5. Attentional-attractibility	12. Fatigability
6. Attentional continuance	13. Reinforceability
7. Attentional absences	14. Cooperativeness

Table 3. MSCA - General Cognitive Index Scores of Children Flagged by PEER

Development attainment	Percentage	Mean GCI	Range GCI
Flagged on PEER	10%	87	62 - 107
Not Flagged on PEER	90%	110	93 - 138

Table 4. Comparison of Children Screened in Various Areas with their Classmates on Teacher Ratings during the Fall and Spring of Kindergarten Year.

	Fall Ratings					Spring Ratings				
AREA SCREENED	Mastery	Social	Academic	Motor	Overall	Mastery	Social	Academic	Motor	Overall
Developmental attainment	.35***	.33***	.32***	.28***	.40***	.46***	.41***	.54***	.43***	.56***
Neuromaturational Status	.08	.13	.07	.09	.09	.11	.04	.05	.10	.08
Processing efficiency	.33***	.36***	.33***	.14	.38***	.37***	.35***	.38***	.14	.41***
Attention-activity	.28***	.28***	.18*	.10	.27***	.22**	.16*	.17*	.20*	.22**

N = 150

* $p \leq .05$
** $p \leq .01$
*** $p \leq .001$

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